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Sediment transport and morphology changes in the Ha!Ha! River: the modeling of the flood event of July 1996

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One of the rivers in the Saguenay region (Quebec) that was most affected by the rainfall of July 1996 is Ha!Ha! River. On Lake Ha!Ha!, the flood led to overtopping and failure of an earth dyke. The rapid drainage of the Lake Ha!Ha! induced the release of some 30 million m^3 of water in addition to the 30 million m^3 contributed by the rainfall. The July flood was thus 8 times the 100-year flood. From the lake to the river mouth, a 35 km reach of the Ha!Ha! riverbed was dramatically modified. Practically, all the typical features of morphological changes were observed along the river: erosion (locally up to 20 m), large-scale widening (sometimes blocked by the presence of bed-rock sills and banks but attained in some locations 280 m), large deposition area, changes in path and bed profile, etc. The present study focuses on the modeling of the hydraulic and morphology processes taking place in the 35 km long of the Ha!Ha! River. RubarBE, 1-D model, is used to investigate the sediment transport and riverbed evolution associated with the flood event of July 1996. The model solves the St-Venant equations for hydrodynamics and the sediment continuity and non-equilibrium bed-load transport equations for morphodynamics. It is an unsteady state model that can deal with different flow regimes (subcritical, supercritical, or a combination of both). Particle size distribution of sediments is represented by the median diameter and a non-uniformity factor σ that accounts for the effect of grain size distribution. The model solves the one-dimensional shallow-water equations by using a second-order explicit scheme. The sediment transport routing is accomplished by a finite difference method. A coupled procedure is used, in which the flow, sediment transport and bed changes are calculated in the same time. The numerical results are compared with the measurements from the field. Good agreement is obtained.